

WHAT IS CLAIMED IS:

1           1.     An  $m \times n$  sensor array, comprising:  
2                 m distribution fiber lines;  
3                 n return fiber lines; and  
4                 n sensor groups, each of said n sensor groups comprising:  
5                     m sensors; and  
6                     input couplers and output couplers, said input couplers and said  
7                     output couplers being connected to respective ones of said sensors, each  
8                     of said input couplers within any one of said n sensor groups being  
9                     connected to a different one of said m distribution fiber lines;  
10                 wherein each of said return fiber lines is connected to all output couplers  
11                 within a respective one of said n sensor groups; and  
12                 wherein coupling ratios of said input couplers in said n sensor groups and  
13                 coupling ratios of said output couplers in said sensor array are chosen to reduce  
14                 differences in the returned optical signal power levels, and wherein the coupling  
15                 ratios of said output couplers connected to a respective return fiber line are  
16                 different from each other.

1           2.     The sensor array of Claim 1, wherein m is 6 and n is 16.

1           3.     The sensor array of Claim 1, wherein each of said distribution fibers is  
2                 coupled only to sensors that are non-adjacent.

1           4.     A sensor array, comprising:  
2                 distribution fiber lines;  
3                 return fiber lines; and  
4                 sensor groups, each of said sensor groups comprising:  
5                     sensors; and  
6                     input couplers and output couplers, said input couplers and said  
7                     output couplers being connected to respective ones of said sensors, each  
8                     of said input couplers within any one of said sensor groups being  
9                     connected to a different one of said distribution fiber lines;

10 wherein each of said return fiber lines is connected to all output couplers  
11 within respective ones of said sensor groups; and

12 wherein coupling ratios of said input couplers and said output couplers in  
13 said signal array are chosen to reduce differences in the returned optical signal  
14 power levels, said input couplers in a first sensor group having a first input  
15 coupling ratio and said input couplers in a second sensor group having a second  
16 input coupling ratio different from said first input coupling ratio, each output  
17 coupler connected to a respective return fiber line from a sensor group having a  
18 coupling ratio that differs from the coupling ratio of the other output couplers  
19 connected to the respective return fiber line, said input coupling ratios and said  
20 output coupling ratios selected in accordance with respective locations of said  
21 input couplers on said distribution fiber lines and respective locations of said  
22 output couplers on said return fiber lines.

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1 5. The sensor array of Claim 4, wherein returned optical signals have  
2 respective powers within a 7 dB range.

1 6. The sensor array of Claim 4, wherein the number of said distribution fiber  
2 lines is 6, and the number of said returned fiber lines is 16.

1 7. The sensor array of Claim 4, wherein optical signals are multiplexed on  
2 said return fiber lines.

1 8. The sensor array of Claim 4, wherein said input couplers and said output  
2 couplers are  $1 \times 2$  couplers.

1 9. The  $m \times n$  sensor array as defined in Claim 1, wherein the coupling ratios  
2 of each output coupler in each of said  $n$  sensor groups is selected in accordance with a  
3 respective location of each output coupler on the return fiber line.

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1 10. The  $m \times n$  sensor array as defined in Claim 1, wherein the coupling ratios  
2 of said input couplers are selected in accordance with respective locations of said input  
3 couplers on said distribution fiber lines, and wherein the coupling ratio of said input  
4 couplers in at least one of said  $n$  sensor groups are different from the coupling ratio of  
5 said input couplers in another of said  $n$  sensor groups.

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1            11.    The  $m \times n$  sensor array as defined in Claim 1, wherein  $n$  is 16, and  
2    wherein the coupling ratios of said input couplers in said sensor groups include coupling  
3    ratios of 3.5%, 7%, 11%, 15%, 20%, 30% and 47%.

1            12.    The  $m \times n$  sensor array as defined in Claim 1, wherein  $m$  is 6, and  
2    wherein the coupling ratios of said output couplers connected to one of said return fiber  
3    lines include coupling ratios of 15%, 20%, 25%, 30% and 47%.

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